IODOMETHANE OFFERS OPPORTUNITIES FOR METHYL BROMIDE PHASE OUT AND SOIL DISINFESTATION IN AUSTRALIA

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Australian horticulture has successfully reduced its consumption of methyl bromide (MB) by 95% since 1995, in accordance with the terms of the *Montreal Protocol*. Of the 20 horticultural industries affected by the MB phase-out in 1995, only one (the strawberry nursery industry) continues to apply for critical-use-exemptions (CUEs) to retain its use. The alternatives adopted in Australian horticulture have varied by region and cropping commodity. For example, the sub-tropical vegetable industry has adopted IPM approaches combining crop rotation with sugar cane and strategic use of soil disinfestants; the floriculture industry has adopted alternative substrates and steam disinfestation; and the strawberry fruit industry has adopted alternative fumigants, such as chloropicrin (Pic) and 1,3 dichloropropene / chloropicrin (1,3-D:Pic). Despite the reduction in MB use in Australia, its phase-out has posed some ongoing challenges for industry. New alternative fumigants, such as iodomethane (IM), offer opportunities for industry to meet these challenges.

Turf Production

The Australian turf industry has adopted alternative fumigants, particularly dazomet, to phase-out MB for pre-plant soil disinfestation. Under correct environmental conditions and application, these alternatives have provided the industry with excellent results. However, the production of elite turf varieties requires purity of line under PBR restrictions, and therefore growers are looking for a greater range of options for improved control of the preceding crop and weeds. Recent trials in the turf industry have demonstrated a strong potential for IM:Pic to provide an alternative of equivalent efficacy to the previous standard MB:Pic. Key results from trials were:

- Formulations of IM:Pic (50:50 and 98:2) controlled weeds and nematodes, and increased yields, to the same level as MB:Pic (50:50, 500 kg/ha).
- Optimum application rates of IM:Pic ranged from 175 – 350 kg/ha, and were dependent on initial weed pressure (Table 1).
- IM:Pic controlled key weed and turf species within the Graminaceae, including *Poa* spp. (winter grass) and the previous crop *Stenotaphrum secundatum* (buffalo grass), to the same level as MB:Pic.

Strawberry Nurseries

Strawberry nurseries are the only Australian horticultural industry currently applying for CUEs to retain MB, due to the high certification and biosecurity standards required for transplant production. The industry has trialed alternative fumigants extensively, but the high elevations and cold temperatures required for growing strawberry transplants has sometimes led to crop phytotoxicity and reduced efficacy of the alternatives in these trials. Therefore, the industry is currently considering fumigants with higher vapor pressures and lower boiling points, such as IM, or plug transplant production in soilless substrates, as alternatives to MB. Key results from recent trials with IM:Pic in the industry were:

- Formulations of IM:Pic (30:70 and 50:50, 300-500 kg/ha) controlled weeds and key pathogens (*Verticillium dahliae*, *Sclerotium rolfsii*, *Phytophthora cactorum*, and *Rhizoctonia fragariae*), and increased yields, to the same level as MB:Pic (50:50, 500 kg/ha).
- A plant back period of ~ 21 days was required for IM:Pic (50:50 and 30:70) under cool (10°C soil temperature at application) conditions in heavy soils.
- No issues (e.g. enhanced biodegradation) were identified with the annual application of IM:Pic into the same soils over a 3-year period.
- IM:Pic controlled natural populations of *R. solani* to the same level as MB:Pic, to a soil depth of at least 80 cm (Table 2).

Protected Horticulture.

Australian protected horticulture has successfully adopted soilless substrates and soil disinfestation with aerated steam as alternatives to MB. However, these alternatives do not suit some cropping commodities (e.g. iris) and conditions (e.g. topography and limited water availability). Although industry has trialed alternative fumigants, difficulties with application have limited their adoption. For example, structural limitations of glasshouses often prevent conventional application (shank injection) of alternative fumigants. For this reason, drip application of alternative fumigants is an attractive method for protected horticulture, because users can apply fumigants from outside the glasshouse. Recent trials defined configurations for optimal drip fumigation (for IM and other alternatives) and demonstrated its potential application in protected horticulture. Key results from trials were:

- Drip irrigation systems running 2-hrs, with emitter flow rates of 1 L/hr and spacings of 20 cm were effective in delivering water and fumigant (e.g. IM) evenly through sandy clay soils.
- Drip fumigation (IM:Pic, 50:50, 500 kg / ha) provided equivalent pathogen (*S. rolfsii*) and weed control to shank injection (IM:Pic, 50:50, 500 kg / ha) and hot gas MB (MB:Pic, 98:2, 1000 kg / ha)

Strawberry Fruit

The strawberry fruit industry have successfully adopted Pic and 1,3-D:Pic as alternatives to MB, and these fumigants have maintained crop health, productivity and profits. However, growers are looking for a greater range of options so they can adopt fumigant rotations. Previous replicated trials have established the efficacy of IM:Pic for strawberry fruit production, and recent trials have evaluated its use on a commercial scale. Key results from trials were:

- IM:Pic (30:70, 500 kg/ha) and 1,3-D:Pic (65:35, 500 kg/ha) controlled weeds and improved crop health and yields to equivalent levels as MB (MB:Pic 50:50, 500 kg / ha).
- These participatory trials demonstrated the performance of alternative fumigants to growers under local environmental conditions and agronomic practices, and will assist in promoting adoption.

Conclusions

IM is a highly efficacious fumigant that, together with other non-fumigant and fumigant approaches, offers Australian horticulture more robust systems for phasing out and maintaining the phase-out of MB. Currently, IM is still in the registration process in Australia (registration anticipated in late 2008). However, experimental-use permits are in place to commence further participatory commercial trials and economic evaluation in the strawberry nursery industry.

Table 1 – Evaluation of IM and Pic for controlling weeds under high (473 weeds / m^2) and low weed pressures (6 weeds / m^2), 27 DAF.

Treatment	**Species Diversity (No. of species / m^2)**	
	High Weed Pressure	**Low Weed Pressure**
Untreated	5.8	2.0
MB:Pic (50:50, 500 kg / ha)	0.3	0.8
MB:Pic (50:50, 350 kg / ha)	1.8	1.3
IM:Pic (50:50, 350 kg / ha)	0.8	1.0
IM:Pic (50:50, 250 kg / ha)	0.8	1.3
IM:Pic (98:2, 250 kg / ha)	1.3	1.3
IM:Pic (98:2, 175 kg / ha)	2.5	1.3
Pic (175 kg / ha)	2.0	1.3
LSD	1.4	NS

Table 2 – Evaluation of MB (MB:Pic 50:50, 500 kg/ha) and IM (IM:Pic 30:70, 500 kg/ha) for controlling natural populations of *Rhizoctonia solani* (AG 2.1 and AG 3) in commercial strawberry nurseries in Australia. Concentrations expressed as pg DNA / g soil. Figures followed by different letters are significantly different ($P < 0.05$).

***Rhizoctonia solani* (AG 2.1)**		**Depth (cm)**		
Treatment	**Time of Assessment**	**10 cm**	**30 cm**	**80 cm**
Untreated	Pre-fumigation	51.5 b	-	-
MB:Pic (50:50, 500 kg / ha)	Planting (12 WAF)	0.50 a	0.00 a	0.00 a
IM:Pic (50:50, 500 kg / ha)	Planting (12 WAF)	0.50 a	0.17 a	0.00 a
***Rhizoctonia solani* (AG 3)**		**Depth (cm)**		
Treatment	**Time of Assessment**	**10 cm**	**30 cm**	**80 cm**
Untreated	Pre-fumigation	60.8 b	-	-
MB:Pic (50:50, 500 kg / ha)	Planting (12 WAF)	0.17 a	0.67 a	0.17 a
IM:Pic (50:50, 500 kg / ha)	Planting (12 WAF)	0.67 a	0.00 a	0.00 a